ON THE RADULÆ OF *VITREA HELVETICA*, BLUM., AND THE ALLIED SPECIES.

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The radula of *V. helvetica*, Blum. (Fig. 2), is a very characteristic organ, and by it the species may be distinguished from other *Vitreæ*, so far as my own investigations have gone. The central tooth is small, and its basal plate remarkably quadrate ; central cusp long, with sides

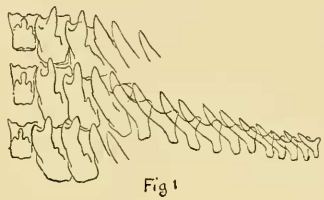

Fig 1

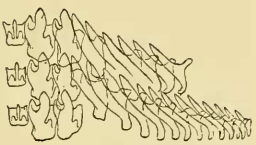

Fig 2

Fig 3

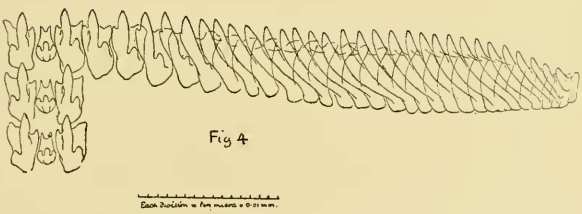

Fig 4

Each division of the scale represents ten micra.

nearly parallel. There are but two well-developed laterals (admedians), and these are also remarkable for the squared character of their basal plates. Their mesocone and endocone together are of a compactly rounded shape, somewhat suggestive of the appearance of a half-closed fist ; the ectocone is closer than usual to the mesocone, on account of

the abbreviated shape of the whole tooth. The tooth which follows may be regarded as transitional or first marginal with equal propriety; it is furnished with a very slight prominence marking the place of an endocone. There are 13 to 16 marginals, closely set, with very curved basal plates; their cusps are of average length, and do not overlap the next row to any great extent.

The specimen here figured was extracted by me from one of the original specimens from Solothurn, now in Mr. Kennard's collection. My warmest thanks are due to him for permitting the somewhat risky operation of extraction to be performed on so valuable a specimen. The proximal parts of the genitalia, showing an extremely short vas deferens, commencing two-thirds of the way down the sheath of the male organ, and a shoe-shaped spermatheca with a short, stout, and twisted duct, are shown at Fig. 5 of the accompanying illustrations.

Mr. B. B. Woodward, with his invariable kindness, has permitted me to make a careful examination of the specimen (radula) of *V. helvetica* which he described in 1903, when he showed that the English specimens referred to *helvetica* could not well be that species, and therefore gave them the name of *Rogersi*, in honour of the original British discoverer. It has been remarked by several students of the group that the specimen figured by Woodward seemed to be abnormal, in respect of possessing a first admedian without separated endocone. That was the conclusion I myself had formed from an examination of the figure. When Mr. Woodward first showed me the specimen, some months ago, I had to admit that the peculiarity occurred with such regularity, on both sides of the radula, that it might be a normal feature. On that occasion it was examined with a Zeiss D objective. After that came the preparation of the companion radula, from the shell in Mr. Kennard's collection; and this is very markedly normal; i.e., it has the type of admedian to which we are accustomed in this group of *Vitreæ*. I then made a number of preparations of *Vitreæ*, fixing the radula together with its natural investments, taking particular care not to remove the cells which coat the upper surface of the unused part, but to fix them with as little shrinkage as possible. These preparations show that the rounded cavity between the endocone and mesocone is normally filled up by a group of cells which seem to act as a plug to prevent the advance of chitinisation in that cavity, while the other surfaces of the cusps continue to become thickened till the middle of the organ is reached. On closely examining Mr. Woodward's *helvetica* radula with apochromatic objectives of unexceptionable definition, I soon came to the conclusion that the only material difference between it and Mr. Kennard's specimen was that this group of cells had itself become impacted and chitinised in the cavity. I have since found several other instances of the same kind of thing; it may be described as a very slight pathological abnormality. Abnormalities arising from fusion of basal plates are not rare in this group, but they rarely occur on both sides of the radula symmetrically. A group of teeth from Mr. Woodward's specimen is here figured (Fig. 3); the emphasising of the endocone of the transitional tooth figured is not a constant character throughout.

In order to study *V. Rogersi*, which is well known to be a very variable form, it is desirable to have frequent access to a locality where it abounds; Mr. Kennard kindly indicated to me such a locality near Westerham. There is in the Westerham specimens a considerable amount of variation in the length of the mesocone of the central tooth; the central tooth is also frequently asymmetrical, and bears an additional ectocone on one side. The exact shape of the admedians is also very variable, as shown in the example figured (Fig. 1). When, as in the top row in that figure, there is a shortening of the teeth, a kind of ridge is formed at the base of the tooth, clearly marking the process as abnormal; and this kind of abnormality has no tendency to be repeated in series. One never finds the neat and distinct quadration of the basal plate which is so strongly marked in *helvetica*. The basal plates of centrals and admedians are much longer; the cusps of the centrals are rounded or ovate; mesocone of admedians more slender, ectocones having a tendency to disappear, or to be reduced so as to suggest a serration. It ought to be mentioned that with a microscope of poor defining power the appearance of serration is often given where there is merely a slight irregularity of contour, the eye not being able to distinguish between true contours and interference effects; the pectinations on the teeth of *Physa fontinalis*, which are in reality thin, equal, and parallel, though wedge-shaped in section, form a most excellent test for the objective to be used for examining radulæ. The marginal teeth of *V. Rogersi* are comparatively short and not closely set, totally unlike those of either *glabra* or *helvetica*. In general, the variation of *Rogersi* is non-significant, being due mainly to looseness of build.

Fig 5 Fig 6 Fig 7

Fig. 6 represents the proximal part of the genitalia of a Westerham *Rogersi*, for comparison with Fig. 5 (*helvetica*). The duct of the spermatheca, which is soft and flexible, containing less muscular fibre than do the other canals, has been dissected out and is here shown laid over the first half-turn of the female epididymis. The vas deferens

has merely been turned over from its more central normal position; the flexures shown are found pretty uniformly.

Mr. W. Moss has most kindly lent me, and allowed me to figure, a radula from his collection inscribed "*Hy. glabra*, Studer. Per Prof. Simroth. Leipsic. 28/9/98. 470." The dentition of this is shown in Fig. 4. There is no need of detailed description to prove that this is not an ordinary British *Vitrea*. The genitalia of the same specimen have also been lent me by Mr. Moss, and are figured here (Fig. 7). (The flexures of the male side and of the duct of the spermatheca are partially accidental.) I have no doubt that Mr. Moss was right in the opinion which he expressed to me in 1897, to the effect that the Anglesey '*glabra*' (which I have also studied in their native land) are near to, but not identical with, this form.

It appears to me that according to the anatomical characters the *Vitreæ* of this group may be arranged in a series of couples, somewhat after this manner:—

lucida vera, ? affinities with *olivetorum* group.
Draparnaldi and *glabra* (Fig. 4).
hibernica and *Scharffi*.
cellaria and *Rogersi*.
helvetica and *alliaria*.

This may of course be purely artificial, but it is based on a general consideration of the variable points. It is worth noting that the species above enumerated may be distinguished by comparison of their basal plates. In order to see these clearly and with certainty they should be stained, and the preparation mounted in Canada balsam. The stain of carbol thionin (which is very convenient for quick work) will keep in glycerine, for a temporary mount, for a few weeks only.

I am very willing to examine any British specimens that may be supposed to be true *V. helvetica*, Blum. They are best sent in a fresh condition. This paper ought not to close without a small word of thanks to our President for observing and maintaining the distinctness of *V. helvetica* and *V. Rogersi*.

REFERENCE TO ILLUSTRATIONS.

Fig. 1. Radula of *Vitrea Rogersi*, Woodward. (Westerham.)
,, 2. Radula of *Vitrea helvetica*, Blum. (Solothurn co-type; Mr. Kennard's specimen.)
,, 3. Part of radula of *Vitrea helvetica*, Blum. (Solothurn co-type; British Museum specimen.)
,, 4. Radula of *Vitrea glabra*, Studer. (From Professor Simroth, Leipsic; lent by Mr. W. Moss.)
,, 5. Genitalia of No. 2.
,, 6. Genitalia of No. 1.
,, 7. Genitalia of No. 4.

☞ The magnification of Nos. 1, 2, and 4 may be ascertained from the scale; that of No. 3 is slightly greater, it having been necessary to employ a different objective.